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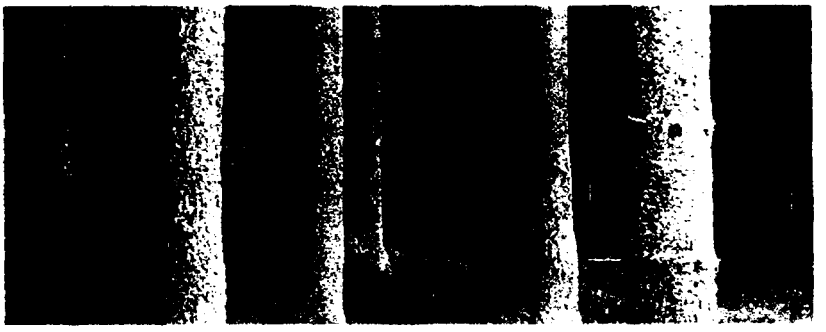
Report



Phase I Removal Action Report Addendum

Riverdale Chemical Company

June 2001

Off-Site Drainage Ditch Sampling

Prepared For

Nufarm

Prepared By

RMT

RMT, Inc. 222 South Riverside Plaza, Suite 820 • Chicago, IL 60606 • 312/575-0200 • 312/575-0300 (FAX)

RMT Integrated Environmental Solutions

222 South Riverside Plaza
Suite 820
Chicago, IL 60606
Telephone: 312-575-0200
Fax: 312-575-0300

June 27, 2001

Ms. Callie Bolattino
On-Scene Coordinator
United States Environmental Protection Agency - Region 5
Emergency Response Branch
77 West Jackson Boulevard (SE-5J)
Chicago, IL 60640

Subject: Phase I Removal Action Report Addendum
Off-Site Drainage Ditch Sampling

Dear Callie:

This Phase I Removal Action Addendum Report was prepared on behalf of Riverdale Chemical Company (Riverdale), to summarize the off-site ditch sampling activities. The work was conducted as described in the Phase I RA Workplan dated October 2000.

On March 5th, four soil borings (SL85 through SL88) were advanced utilizing a push probe sampler in the off-site drainage ditch running along the southern border of the site. One soil boring (SL89) was advanced in the low-lying area southeast of the site. The sampling locations are shown on Figure 1 . Soil samples were collected from the soil borings to determine potential extent, if any, of concentrations of compounds which exceed risk levels.

The samples from the ditch (SL85 through SL88) were analyzed for full Target Compound List (TCL), including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, and herbicides, and Target Analyte List (metal analyses). Two samples (SL87-1 and SL87-3) were analyzed for high-resolution dioxin (SW846 Method 8290). The sample collected from the low-lying area (SL89) was analyzed for pesticides/PCBs and herbicides.

Sample results are provided in the following tables:

- Table 1 – Pesticide and Dioxin Sampling Results
- Table 2 - Herbicide Sampling Results
- Table 3 – Volatile Organic Compound Sampling Results
- Table 4 – Semi-Volatile Organic Compound Sampling Results
- Table 5 – Metals Sampling Results

The results of the sampling at the off-site drainage ditch and low-lying area indicate minimal impact. Risk calculations for the off-site drainage ditch indicate the total cancer risk ranges from 4.53×10^{-9} to 3.70×10^{-7} and hazard index (HI) ranges from 2.98×10^{-4} to 5.76×10^{-2}. The calculated values for cancer risk and hazard index for the low-lying area were 1.13×10^{-8} and 1.20×10^{-3}, respectively. Risk calculations are provided in Appendix A.

The concentrations of compounds detected in the off-site ditch and low lying area are indicated on Figure 2 and Figure 3. Minimal impact was observed at sample locations SL85, SL87 and SL88 (Figure 2). Low concentrations of pesticides were detected at sampling location SL86-1, including aldrin at 340 micrograms per kilogram (µg/kg), dieldrin at 610 µg/kg, gamma-chlordane at 240 µg/kg, and alpha-chlordane at 190 µg/kg. Dioxins (2,3,7,8 TCDD and its congeners) were analyzed at locations SL87-1 and SL87-3. The calculated toxicity equivalents at SL87-1 was 2.55 nanograms per kilogram (ng/kg) and at SL87-3 was 1.61 ng/kg, well below the 5 µg/kg risk level. TEQ calculations are provided in Appendix B. An evaluation of the data quality is provided in Appendix C.

Herbicides were not detected in any sample. The low levels of VOCs and SVOCs detected in the ditch did not exceed any risk-based cleanup levels. The levels of metals detected in the ditch are consistent with the established background levels and with data previously collected at the site.

The low level of pesticides detected at the low-lying area (SL89) were similar to the data previously collected at that location (Figure 3). These results are consistent with the observation that the low-lying area has not been impacted by site activities.

Should you have any questions or require additional information, please contact us at (312) 575-0200

Sincerely,

RMT, Inc.

Brendan P. McLennan
Environmental Engineer

Rae Mindock
Project Manager

Attachments: Tables 1 through 5
Figures 1 through 3
Appendices A, B and C

cc: Karen Peacemen, U.S. EPA
Peter Bibby, Riverdale
Todd Wiener, MWE

Table 1

Pesticide/PCB & Dioxin Analytical Results - Off Site Drainage Ditch & Low-Lying Area

Riverdale Chemical Company - Chicago Heights, Illinois

Parameter	Sample Location							
	SL85-1	SL86-1	SL86-3	SL87-1	SL87-3	SL87-3Dup	SL89-1	SL89-1
PESTICIDES/PCBs								
Heptachlor epoxide	12	70 Pj	ND	7.0 Pj	ND	ND	ND	3.1 Pj
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	33 JPj	ND	110 Pj	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND	ND	68 Pj	ND
Aroclor 1016	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ND	370 C	10	2.1 J	ND	ND	ND	2.1 J
alpha-BHC	ND	42	ND	ND	ND	ND	ND	ND
beta-BHC	ND	73	1.5 JPj	1.6 J	ND	ND	ND	ND
delta-BHC	ND	65	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	49 P	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	22 Pj	ND	12 Pj	ND	ND	35	11
alpha-Chlordane	ND	210 Pj	ND	1.9 J	ND	ND	ND	2.6 Pj
gamma-Chlordane	ND	250	1.3 J	2.1 JPj	ND	ND	2.9 P	7
Aroclor 1242	ND	ND	ND	33 JP	ND	ND	ND	ND
Endrin ketone	ND	9.2 JPj	ND	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	ND	31	ND	ND	ND	ND	ND	ND
Dieldrin	ND	610	5.1	8.6	ND	ND	8.7	20
Endrin	ND	25 Pj	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	ND	190	ND	3.2 JPj	ND	ND	ND	14
4,4'-DDE	ND	85	ND	5.7	ND	ND	51	11
Endrin aldehyde	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	19 Pj	ND	ND	ND	ND	ND	ND
DIOXIN								
2,3,7,8-TCDD	NA	NA	NA	0.0019	0.0012	ND	NA	NA

Notes:

All concentrations are presented in micrograms per kilogram (mg/kg).

C = The presence of the compound was confirmed by GC/MS analysis.

P = The percent difference between the original and confirmation analyses is greater than 25 percent.

J = Estimated result. Result is less than the reporting limit.

j = When the difference for detected pesticide result between the two GC columns was greater than 30 percent, a data validation qualifier was added to suggest uncertainty in the result.

ND = Analyte was analyzed for, but not detected.

NA = Not analyzed.

Table 2

Metals Analytical Results - Off Site Drainage Ditch & Low-Lying Area

Riverdale Chemical Company - Chicago Heights, Illinois

Parameter	Sample Location						
	SL85-1	SL86-1	SL86-3	SL87-1	SL87-3	SL87-3Dup	SL88-1
Aluminum	14,800	5,850	13,400	13,700	12,700	10,700	10,800
Iron	27,000	25,600	22,500	33,700	19,000	33,000	15,700
Lead	19.4	102	10.6	31.3	17.3	16.8	28.8
Magnesium	5,160	5,780	24,500	2,980	2,590	2,940	2,100
Manganese	686 j	321	462	668	475	540	588
Mercury	ND	0.11 Bu	ND	ND	0.11 Bu	0.11 Bu	0.074 Bu
Nickel	41.3	21.3	30.3	19.5	20.1	44.6	14.4
Potassium	1,870	693 B	2,580	1240 B	964 B	1100 B	1320 B
Silver	ND	ND	ND	ND	ND	ND	ND
Sodium	ND	ND	ND	ND	ND	ND	ND
Thallium	ND	ND	ND	ND	ND	ND	ND
Antimony	ND	ND	ND	ND	ND	ND	ND
Arsenic	10.7 Nj	22.1 N	7.7 N	8.6 N	5.3 N	12.3 N	5.5 N
Barium	104	76.2	62	106	99.4	95.7	101
Beryllium	0.41 Bu	0.35 Bu	0.23 Bu	0.48 Bu	0.52 B	0.59 B	0.37 Bu
Cadmium	ND	1.4	0.091 Bu	0.082 Bu	ND	ND	0.16 Bu
Chromium	22.5	51.8	21.7	20.7	16.9	18.2	13.7
Cobalt	18	6.6	11.4 B	7.9 B	9.9 B	17.5	6.9 B
Copper	25.1	74.7	18.3	53	13.2	38.2	24.2
Vanadium	23.6	17.6	22.2	27.8	22.7	27.9	19.1
Zinc	63.9	427	60.3	86.9	43.8	59.7	84.9
Calcium	2,580	11,900	61,400	5,910	3,080	2,120	4,520
Selenium	ND	2.7	ND	ND	ND	ND	ND

Notes:

All concentrations are presented in milligrams per kilogram (mg/kg).

N = Spiked analyte recovery is outside stated control limits.

B = Estimated result. Result is less than reporting limit.

j = When specific QC criteria are outside the established control limits, the reported concentration or the Quantitation limit is approximate.

u = Analye was present at less than 10 times the concentration in the associated method, trip, field, and/or laboratory storage blank for common laboratory contaminants, or at less than 5 times the blank concentration of other analytes, and is therefore qualified as nondetectable according to U.S. EPA data validation procedrures.

ND = Analyte was analyzed for, but not detected.

Table 3

Herbicide Analytical Results - Off Site Drainage Ditch & Low-Lying Area

Riverdale Chemical Company - Chicago Heights, Illinois

	Sample Location							
Parameter	**SL85-1**	**SL86-1**	**SL86-3**	**SL87-1**	**SL87-3**	**SL87-3Dup**	**SL88-1**	**SL89-1**
2,4,5-TP (Silvex)	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-T	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

ND = Analyte was analyzed for, but not detected.

Table 4

VOCs Analytical Results - Off Site Drainage Ditch & Low-Lying Area

Riverdale Chemical Company - Chicago Heights, Illinois

Parameter	Sample Location						
	SL85-1	SE86-1	SE86-3	SE87-1	SE87-3	SE87-3Dup	SL88-1
Ethylbenzene	ND	ND j	ND	ND	ND	ND	ND j
Styrene	ND	ND j	ND	ND	ND	ND	ND j
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND j	ND	ND	ND	ND	ND j
Chlorobenzene	ND	7.5 Jj	ND	ND	ND	ND	ND j
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND j	ND	ND	ND	ND	ND j
Xylenes (total)	ND	ND j	ND	ND	ND	ND	ND j
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	ND	ND
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND	ND
Acetone	1.3 JBsu	17 Bu	ND	7.3 JBsu	6.7 JBsu	2.3 JBsu	2.5 JBsu
Chloroform	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND	ND	ND
Chloromethane	ND	17	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	ND	ND	ND	ND	ND	ND	ND
Carbon disulfide	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND
2-Butanone	ND	6.5 J	500 J	2.1 J	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND j	ND	ND	ND	ND	ND j

Notes:

All concentrations are presented in micrograms per kilogram (mg/kg).

J = Estimated result. Result is less than the reporting limit.

B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.

j = When specific QC criteria are outside the established control limits, the reported concentration or the Quantitiation Limit is approximate.

s = Analyte was present in laboratory holding/storage blank.

u = Analyte was present at less than 10 times the concentration in the associated method, trip, field, and/or storage blank for common laboratory contaminants, or at less than five times the blank concentration of other analytes, and is therefore qualified as nodetectable according to U.S. EPA data validation procedure.

ND = Analyte was analyzed for, but not detected.

Table 5

SVOCs Analytical Results - Off Site Drainage Ditch & Low-Lying Area

Riverdale Chemical Company - Chicago Heights, Illinois

Parameter	SED-1	SED-1	SED-1	SED-1	SED-1	SED-1	SED-1
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND
4-Chloroaniline	ND	ND	ND	ND	ND	ND	ND
2,2'-Oxybis(1-Chloropropane)	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl) ether	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl) phthalate	ND	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate	ND	ND	ND	ND	ND	240 J	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	130 J	ND	ND	ND	ND	ND
Dimethyl phthalate	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND
Benzo(ghi)perylene	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	68 J	ND	ND	ND	ND	ND
Fluoranthene	ND	100 J	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	80 J	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ND	52 J	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodi-n-propylamine	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	90 J	ND	ND	ND	ND
Diethyl phthalate	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	ND	61 J	ND	ND	ND	ND	ND
Phenanthrene	ND	130 J	ND	ND	ND	ND	ND
Butyl benzyl phthalate	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	62 J	ND	ND	ND	ND
Carbazole	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND

Table 5

SVOCs Analytical Results - Off Site Drainage Ditch & Low-Lying Area

Riverdale Chemical Company - Chicago Heights, Illinois

Parameter	Sample Location						
	SL85-1	SL86-1	SL86-3	SL87-1	SL87-3	SL87-3Dup	SL88-1
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	250 J	3,400	ND	ND	ND	ND
2-Methylnaphthalene	ND	880	7,600	69 J	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND

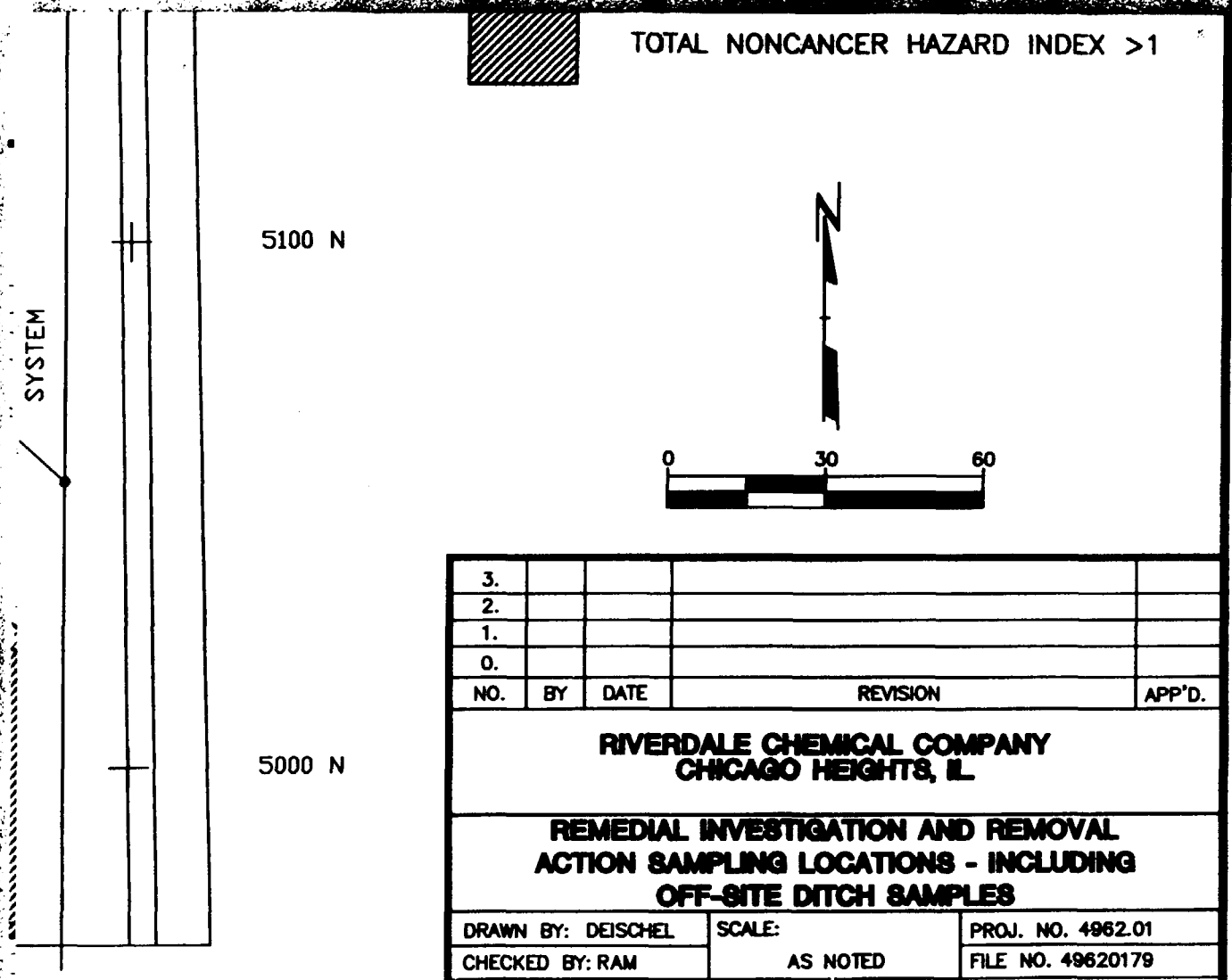
Notes:

All concentrations are presented in micrograms per kilogram (mg/kg).

J = Estimated result. Result is less than the reporting limit.

ND = Analyte was analyzed for, but not detected.

FIGURES



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RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, IL

REMEDIAL INVESTIGATION AND REMOVAL ACTION SAMPLING LOCATIONS - INCLUDING OFF-SITE DITCH SAMPLES

DRAWN BY: DEISCHEL	SCALE: AS NOTED	PROJ. NO. 4962.01
CHECKED BY: RAM		FILE NO. 49620179
APPROVED BY: RAM		**FIGURE 1**
DATE: APRIL 2001		

Oversized maps can be viewed at U.S. EPA Region V Superfund Records Center

150 N. Patrick Blvd.
Brookfield, WI 53045-5854
Phone: 414/879-1212
Fax: 414/879-1220

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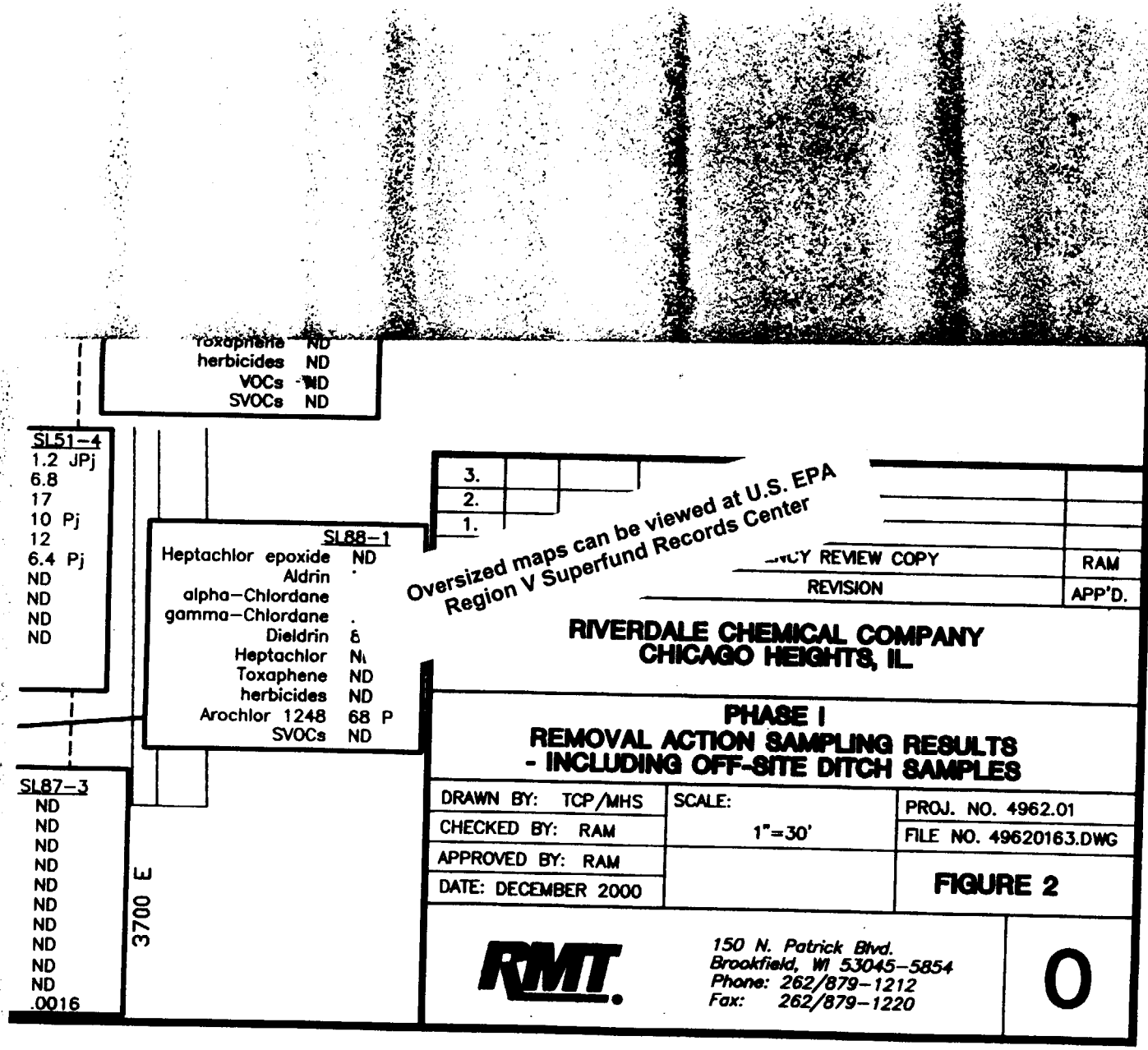
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herbicides ND
VOCs ND
SVOCs ND
SL51-4
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Aldrin
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Dieldrin
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RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, IL
PHASE I
REMOVAL ACTION SAMPLING RESULTS
- INCLUDING OFF-SITE DITCH SAMPLES
DRAWN BY: TCP/MHS
CHECKED BY: RAM
APPROVED BY: RAM
DATE: DECEMBER 2000
SCALE:
1"=30'
PROJ. NO. 4962.01
FILE NO. 49620163.DWG
FIGURE 2
RMT
150 N. Patrick Blvd.
Brookfield, WI 53045-5854
Phone: 262/879-1212
Fax: 262/879-1220
0

NOTES:

NO.	BY	DATE	REVISION	APP'D.
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Oversized maps can be viewed at U.S. EPA
Region V Superfund Records Center

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SCALE: 1"=30'

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, IL

LOW LYING AREA
SAMPLING RESULTS
- INCLUDING SAMPLE SL89

DRAWN BY: MHS	SCALE:	PROJ. NO. 4962.01
CHECKED BY: RAM	1"=30'	FILE NO. 49620164.DWG
APPROVED BY: RAM		FIGURE 3
DATE: DECEMBER 2000		

RMT

150 N. Patrick Blvd.
Brookfield, WI 53045-5854
Phone: 262/879-1212
Fax: 262/879-1220

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Appendix A
Risk Calculations

Total Cancer Risk
Off-Site Drainage Ditch
Riverdale Chemical Company - Chicago Heights, Illinois

Sampling Location	Analyte							Total Cancer Risk
	Aldrin	Dieldrin	Chlordane	Heptachlor	Heptachlor Epoxide	Toxaphene	2,3,7,8-TCDD	
SL85-1	3.69E-10	6.78E-10	5.65E-11	9.77E-11	2.37E-09	2.39E-09	NA	5.96E-09
SL86-1	1.26E-07	2.12E-07	1.21E-08	2.49E-10	1.38E-08	6.09E-09	NA	3.70E-07
SL86-3	3.69E-09	1.77E-09	7.06E-11	1.17E-10	2.37E-10	2.87E-09	NA	8.76E-09
SL87-1	7.75E-10	2.99E-09	1.13E-10	1.17E-10	1.38E-09	2.87E-09	6.19E-09	1.44E-08
SL87-3	4.06E-10	7.30E-10	6.21E-11	1.08E-10	2.17E-10	2.63E-09	3.91E-09	8.06E-09
SL87-3 Dup	3.88E-10	7.12E-10	5.93E-11	1.03E-10	2.08E-10	2.51E-09	5.54E-10	4.53E-09
SL88-1	4.25E-10	3.02E-09	1.14E-10	1.12E-10	2.27E-10	2.75E-09	NA	6.65E-09
SL89-1 (3)	7.75E-10	6.95E-09	2.71E-10	1.17E-10	3.06E-10	2.87E-09	NA	1.13E-08

Notes:

(1) Risk was calculated based on assumptions in RI baseline risk assessment.

(2) If the analyte concentration was below method detection limit, half of the method detection limit was used as the exposure point concentration (EPC).

(3) Sample collected from low-lying area.

NA - Not Analyzed

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL85-1

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d)			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Risk	Risk Percentage %
		Oral Slope Factor (SFO)	Dermal Slope Factor (SFD)	Inhalation Slope Factor (SFI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime Risks (CRD) (unitless)	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime Risks (CRIS) (unitless)	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime Risks (CRIV) (unitless)	Amount Ingested (IDIG), (mg/kg-d)	Lifetime Risks (CRIG) (unitless)		
PESTICIDES/PCBs																	
Aldrin	1.0E-03	1.7E+01	1.7E+01	1.7E+01	1	0.10		9.0E-12	1.5E-10	8.2E-16	1.4E-14			1.3E-11	2.2E-10	3.7E-10	6.19
Dieldrin	2.0E-03	1.6E+01	1.6E+01	1.6E+01	1	0.10		1.8E-11	2.8E-10	1.6E-15	2.6E-14			2.5E-11	4.0E-10	6.8E-10	11.37
Chlordane	2.0E-03	1.3E+00	1.3E+00	1.3E+00	1	0.10		1.8E-11	2.3E-11	1.6E-15	2.1E-15			2.5E-11	3.3E-11	5.6E-11	0.95
Heptachlor	1.0E-03	4.5E+00	4.5E+00	4.6E+00	1	0.10		9.0E-12	4.1E-11	8.2E-16	3.8E-15			1.3E-11	5.7E-11	9.8E-11	1.64
Heptachlor epoxide	1.2E-02	9.1E+00	9.1E+00	9.1E+00	1	0.10		1.1E-10	9.8E-10	9.9E-15	9.0E-14			1.5E-10	1.4E-09	2.4E-09	39.78
Toxaphene	1.0E-01	1.1E+00	1.1E+00	1.1E+00	1	0.10		9.0E-10	9.9E-10	8.2E-14	9.1E-14			1.3E-09	1.4E-09	2.4E-09	40.07
DIOXIN																	
2,3,7,8-TCDD		1.5E+05	1.5E+05	1.5E+05	1	0.10											
No sample collected																	
Total Cancer Risk									2.5E-09		2.3E-13				3.5E-09	6.0E-09	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1.00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction Inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL86-1

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d)			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Risk	Risk Percentage %
		Oral Slope Factor (SFO)	Dermal Slope Factor (SFD)	Inhalation Slope Factor (SFI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime Risks (CRD) (unitless)	Amount Inhaled (IDIS) (mg/kg-d)	Lifetime Risks (CRIS) (unitless)	Amount Inhaled (IDIV) (mg/kg-d)	Lifetime Risks (CRIV) (unitless)	Amount Ingested (IDIG) (mg/kg-d)	Lifetime Risks (CRIG) (unitless)		
PESTICIDES/PCBs																	
Aldrin	3 4E-01	1 7E+01	1 7E+01	1 7E+01	1	0 10		3 1E-09	5 2E-08	2 8E-13	4 8E-12			4 3E-09	7 4E-08	1 3E-07	33 94
Dieldrin	6 1E-01	1 6E+01	1 6E+01	1 6E+01	1	0 10		5 5E-09	8 8E-08	5 0E-13	8 0E-12			7 8E-09	1 2E-07	2 1E-07	57 32
Chlordane	4 3E-01	1 3E+00	1 3E+00	1 3E+00	1	0 10		3 9E-09	5 0E-09	3 5E-13	4 6E-13			5 5E-09	7 1E-09	1 2E-08	3 28
Heptachlor	2 6E-03	4 5E+00	4 5E+00	4 6E+00	1	0 10		2 3E-11	1 0E-10	2 1E-15	9 7E-15			3 2E-11	1 5E-10	2 5E-10	0 07
Heptachlor epoxide	7 0E-02	9 1E+00	9 1E+00	9 1E+00	1	0 10		6 3E-10	5 7E-09	5 8E-14	5 2E-13			8 9E-10	8 1E-09	1 4E-08	3 74
Toxaphene	2 6E-01	1 1E+00	1 1E+00	1 1E+00	1	0 10		2 3E-09	2 5E-09	2 1E-13	2 3E-13			3 2E-09	3 6E-09	6 1E-09	1 65
DIOXIN																	
2,3,7,8 TCDD		1 5E+05	1 5E+05	1 5E+05	1	0 10											
No sample collected																	
Total Cancer Risk									1 5E-07		1 4E-11				2 2E-07	3 7E-07	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm^2)	0 122
Body Weight, BW (kg)	71 8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * ICR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL86-3

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d)			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Risk	Risk Percentage %
		Oral Slope Factor (SFO)	Dermal Slope Factor (SFD)	Inhalation Slope Factor (SFI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime Risks (CRD) (unitless)	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime Risks (CRIS) (unitless)	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime Risks (CRIV) (unitless)	Amount Ingested (IDIG), (mg/kg-d)	Lifetime Risks (CRIG) (unitless)		
PESTICIDES/PCBs																	
Aldrin	1 0E-02	1 7E+01	1 7E+01	1 7E+01	1	0 10		9 0E-11	1 5E-09	8 2E-15	1 4E-13			1 3E-10	2 2E-09	3 7E-09	42 17
Dieldrin	5 1E-03	1 6E+01	1 6E+01	1 6E+01	1	0 10		4 6E-11	7 3E-10	4 2E-15	6 7E-14			6 5E-11	1 0E-09	1 8E-09	20 24
Chlordane	2 5E-03	1 3E+00	1 3E+00	1 3E+00	1	0 10		2 3E-11	2 9E-11	2 1E-15	2 7E-15			3 2E-11	4 1E-11	7 1E-11	0 81
Heptachlor	1 2E-03	4 5E+00	4 5E+00	4 6E+00	1	0 10		1 1E-11	4 9E-11	9 9E-16	4 5E-15			1 5E-11	6 9E-11	1 2E-10	1 34
Heptachlor epoxide	1 2E-03	9 1E+00	9 1E+00	9 1E+00	1	0 10		1 1E-11	9 8E-11	9 9E-16	9 0E-15			1 5E-11	1 4E-10	2 4E-10	2 71
Toxaphene	1 2E-01	1 1E+00	1 1E+00	1 1E+00	1	0 10		1 1E-09	1 2E-09	9 9E-14	1 1E-13			1 5E-09	1 7E-09	2 9E-09	32 74
DIOXIN																	
2,3,7,8 TCDD		1 5E+05	1 5E+05	1 5E+05	1	0 10											
No sample collected																	
Total Cancer Risk									3 6E-09		3 3E-13				5 1E-09	8 8E-09	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL87-1

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d) Oral Slope Factor (SFO)	Dermal Slope Factor (SFO)	Inhalation Slope Factor (SFI)	Absorption factor, unitless Oral (ABO)	Orm (ABS)	Volatilization factor (VF), m^3/kg	Dermal Absorption Amount Absorbed (IDD), mg/kg-d	Dermal Absorption Lifetime Risks (CRD) (unitless)	Volatile Inhalation from soil dust Amount Inhaled (IDIS) (mg/kg-d)	Volatile Inhalation from soil dust Lifetime Risks (CRIS) (unitless)	Volatile Inhalation from volatiles Amount Inhaled (IDIV) (mg/kg-d)	Volatile Inhalation from volatiles Lifetime Risks (CRIV) (unitless)	Ingestion Amount Ingested (IDIG) (mg/kg-d)	Ingestion Lifetime Risks (CRIG) (unitless)	Total Risk	Risk Percentage %
PESTICIDES/PCBs																	
Aldrin	2 1E-03	1 7E+01	1 7E+01	1 7E+01	1	0 10		1 9E-11	3 2E-10	1.7E-15	2 9E-14			2 7E-11	4 5E-10	7 8E-10	5 37
Dieldrin	8 6E-03	1 6E+01	1.6E+01	1 6E+01	1	0 10		7 7E-11	1 2E-09	7 1E-15	1.1E-13			1 1E-10	1 8E-09	3 0E-09	20 70
Chlordane	4.0E-03	1 3E+00	1 3E+00	1 3E+00	1	0 10		3 6E-11	4.7E-11	3 3E-15	4.3E-15			5.1E-11	6 6E-11	1 1E-10	0 78
Heptachlor	1 2E-03	4 5E+00	4 5E+00	4.6E+00	1	0 10		1 1E-11	4 9E-11	9 9E-16	4 5E-15			1 5E-11	6 9E-11	1 2E-10	0 81
Heptachlor epoxide	7 0E-03	9 1E+00	9 1E+00	9 1E+00	1	0 10		6 3E-11	5 7E-10	5 8E-15	5 2E-14			8 9E-11	8 1E-10	1 4E-09	9 58
Toxaphene	1 2E-01	1 1E+00	1 1E+00	1.1E+00	1	0 10		1 1E-09	1 2E-09	9 9E-14	1.1E-13			1 5E-09	1 7E-09	2 9E-09	19 86
DIOXIN																	
2,3,7,8-TCDD	1 9E-06	1 5E+05	1 5E+05	1 5E+05	1	0 10		1 7E-14	2 6E-09	1 6E-18	2 3E-13			2 4E-14	3 6E-09	6.2E-09	42 883
Total Cancer Risk									6 0E-09		5 5E-13				8 5E-09	1 4E-08	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL87-3

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d)			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Risk	Risk Percentage %
		Oral Slope Factor (SFO)	Dermal Slope Factor (SFD)	Inhalation Slope Factor (SFI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime Risks (CRD) (unitless)	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime Risks (CRIS) (unitless)	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime Risks (CRIV) (unitless)	Amount Ingested (IDIG), (mg/kg-d)	Lifetime Risks (CRIG) (unitless)		
PESTICIDES/PCBs																	
Aldrin	1 1E-03	1 7E+01	1 7E+01	1 7E+01	1	0 10		9 9E-12	1 7E-10	9 1E-16	1 5E-14			1 4E-11	2 4E-10	4 1E-10	5 04
Dieldrin	2 1E-03	1 6E+01	1 6E+01	1 6E+01	1	0 10		1 9E-11	3 0E-10	1 7E-15	2 8E-14			2 7E-11	4 3E-10	7 3E-10	9 05
Chlordane	2 2E-03	1 3E+00	1 3E+00	1 3E+00	1	0 10		2 0E-11	2 6E-11	1 8E-15	2 4E-15			2 8E-11	3 6E-11	6 2E-11	0 77
Heptachlor	1 1E-03	4 5E+00	4 5E+00	4 6E+00	1	0 10		9 9E-12	4 5E-11	9 1E-16	4 2E-15			1 4E-11	6 3E-11	1 1E-10	1 33
Heptachlor epoxide	1 1E-03	9 1E+00	9 1E+00	9 1E+00	1	0 10		9 9E-12	9 0E-11	9 1E-16	8 2E-15			1 4E-11	1 3E-10	2 2E-10	2 70
Toxaphene	1 1E-01	1 1E+00	1 1E+00	1 1E+00	1	0 10		9 9E-10	1 1E-09	9 1E-14	1 0E-13			1 4E-09	1 5E-09	2 6E-09	32 60
DIOXIN																	
2,3,7,8-TCDD	1 2E-06	1 5E+05	1 5E+05	1 5E+05	1	0 10		1 1E-14	1 6E-09	9 9E-19	1 5E-13			1 5E-14	2 3E-09	3 9E-09	48 502
Total Cancer Risk									3 3E-09		3 1E-13				4 7E-09	8 1E-09	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm^2)	0 122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction Inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL87-3Dup

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d) Oral Slope Factor (SFO)	Dermal Slope Factor (SFD)	Inhalation Slope Factor (SFI)	Absorption factor, unitless Oral (ABO)	Derm (ABS)	Volatilization factor (VF), m^3/kg	Dermal Absorption Amount Absorbed (IDD), mg/kg-d	Lifetime Risks (CRD) (unitless)	Volatile Inhalation from soil dust Amount Inhaled (IDIS) (mg/kg-d)	Lifetime Risks (CRIS) (unitless)	Volatile Inhalation from volatiles Amount Inhaled (IDIV) (mg/kg-d)	Lifetime Risks (CRIV) (unitless)	Ingestion Amount Ingested (IDIG) (mg/kg-d)	Lifetime Risks (CRIG) (unitless)	Total Risk	Risk Percentage %
PESTICIDES/PCBs																	
Aldrin	1.1E-03	1.7E+01	1.7E+01	1.7E+01	1	0.10		9.5E-12	1.6E-10	8.7E-16	1.5E-14			1.3E-11	2.3E-10	3.9E-10	8.55
Dieldrin	2.1E-03	1.6E+01	1.6E+01	1.6E+01	1	0.10		1.8E-11	3.0E-10	1.7E-15	2.7E-14			2.6E-11	4.2E-10	7.1E-10	15.72
Chlordane	2.1E-03	1.3E+00	1.3E+00	1.3E+00	1	0.10		1.9E-11	2.5E-11	1.7E-15	2.2E-15			2.7E-11	3.5E-11	5.9E-11	1.31
Heptachlor	1.1E-03	4.5E+00	4.5E+00	4.6E+00	1	0.10		9.5E-12	4.3E-11	8.7E-16	4.0E-15			1.3E-11	6.0E-11	1.0E-10	2.26
Heptachlor epoxide	1.1E-03	9.1E+00	9.1E+00	9.1E+00	1	0.10		9.5E-12	8.6E-11	8.7E-16	7.9E-15			1.3E-11	1.2E-10	2.1E-10	4.58
Toxaphene	1.1E-01	1.1E+00	1.1E+00	1.1E+00	1	0.10		9.5E-10	1.0E-09	8.7E-14	9.5E-14			1.3E-09	1.5E-09	2.5E-09	55.35
DIOXIN																	
2,3,7,8-TCDD	1.7E-07	1.5E+05	1.5E+05	1.5E+05	1	0.10		1.5E-15	2.3E-10	1.4E-19	2.1E-14			2.2E-15	3.2E-10	5.5E-10	12.221
Total Cancer Risk									1.9E-09		1.7E-13				2.7E-09	4.5E-09	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1.00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction Inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFO$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL88-1

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d)			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Risk	Risk Percentage %
		Oral Slope Factor (SFO)	Dermal Slope Factor (SFD)	Inhalation Slope Factor (SFI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime Risks (CRD) (unitless)	Amount Inhaled (IDIS) (mg/kg-d)	Lifetime Risks (CRIS) (unitless)	Amount Inhaled (IDIV) (mg/kg-d)	Lifetime Risks (CRIV) (unitless)	Amount Ingested (IDIG) (mg/kg-d)	Lifetime Risks (CRIG) (unitless)		
PESTICIDES/PCBs																	
Aldrin	1 2E-03	1 7E+01	1.7E+01	1.7E+01	1	0 10		1 0E-11	1.8E-10	9 5E-16	1 6E-14			1 5E-11	2 5E-10	4 2E-10	6 39
Dieldrin	8 7E-03	1 6E+01	1.6E+01	1 6E+01	1	0 10		7 8E-11	1 3E-09	7 2E-15	1 1E-13			1 1E-10	1 8E-09	3 0E-09	45 47
Chlordane	4 1E-03	1.3E+00	1.3E+00	1 3E+00	1	0 10		3 6E-11	4 7E-11	3.3E-15	4 3E-15			5 2E-11	6 7E-11	1 1E-10	1 72
Heptachlor	1 2E-03	4 5E+00	4 5E+00	4 6E+00	1	0 10		1 0E-11	4.7E-11	9.5E-16	4 4E-15			1 5E-11	6 6E-11	1 1E-10	1.69
Heptachlor epoxide	1 2E-03	9 1E+00	9 1E+00	9.1E+00	1	0 10		1 0E-11	9.4E-11	9.5E-16	8.6E-15			1.5E-11	1 3E-10	2 3E-10	3.42
Toxaphene	1 2E-01	1.1E+00	1.1E+00	1 1E+00	1	0 10		1 0E-09	1.1E-09	9 5E-14	1.0E-13			1 5E-09	1 6E-09	2 7E-09	41 32
DIOXIN																	
2,3,7,8-TCDD		1 5E+05	1 5E+05	1 5E+05	1	0 10											
No sample collected																	
Total Cancer Risk									2 8E-09		2 5E-13				3 9E-09	6 6E-09	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm^2)	0 122
Body Weight, BW (kg)	71 8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction Inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$

RME ADULT CONSTRUCTION WORKER CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL89-1

Chemical Name	Concentration in soil (CS), mg/kg	Cancer Potency Factors, 1/(mg/kg-d) Oral Slope Factor (SFO)	Dermal Slope Factor (SFD)	Inhalation Slope Factor (SFI)	Absorption factor, unitless Oral (ABO)	Dirm (ABS)	Volatilization factor (VF), m³/kg	Dermal Absorption Amount Absorbed (IDD), mg/kg-d	Dermal Absorption Lifetime Risks (CRD) (unitless)	Volatile Inhalation from soil dust Amount Inhaled (IDIS) (mg/kg-d)	Volatile Inhalation from soil dust Lifetime Risks (CRIS) (unitless)	Volatile Inhalation from volatiles Amount Inhaled (IDIV) (mg/kg-d)	Volatile Inhalation from volatiles Lifetime Risks (CRIV) (unitless)	Ingestion Amount Ingested (IDIG) (mg/kg-d)	Ingestion Lifetime Risks (CRIG) (unitless)	Total Risk	Risk Percentage %
PESTICIDES/PCBs																	
Aldrin	2 1E-03	1 7E+01	1 7E+01	1.7E+01	1	0 10		1.9E-11	3.2E-10	1.7E-15	2 9E-14			2 7E-11	4 5E-10	7 8E-10	6 87
Dieldrin	2 0E-02	1 6E+01	1 6E+01	1 6E+01	1	0 10		1 8E-10	2 9E-09	1.6E-14	2 6E-13			2 5E-10	4 1E-09	7 0E-09	61.58
Chlordane	9 6E-03	1.3E+00	1.3E+00	1 3E+00	1	0 10		8 6E-11	1.1E-10	7.9E-15	1.0E-14			1 2E-10	1 6E-10	2 7E-10	2 40
Heptachlor	1.2E-03	4 5E+00	4.5E+00	4.6E+00	1	0 10		1 1E-11	4.9E-11	9.9E-16	4.5E-15			1.5E-11	6 9E-11	1 2E-10	1 04
Heptachlor epoxide	1 6E-03	9 1E+00	9 1E+00	9.1E+00	1	0.10		1.4E-11	1.3E-10	1.3E-15	1.2E-14			2 0E-11	1.8E-10	3.1E-10	2 71
Toxaphene	1 2E-01	1 1E+00	1 1E+00	1.1E+00	1	0 10		1.1E-09	1.2E-09	9 9E-14	1.1E-13			1.5E-09	1.7E-09	2 9E-09	25 40
DIOXIN																	
2,3,7,8-TCDD		1.5E+05	1 5E+05	1.5E+05	1	0 10											
No sample collected																	
Total Cancer Risk									4.7E-09		4.3E-13				6 6E-09	1 1E-08	100

ASSUMPTIONS

Averaging Time, AT (yr)	75
Adherence Factor, AF (mg/cm²)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m³/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m³/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm²/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD * ET}{BW * AT * TCF * TC}$$

$$CRD = IDD * SFD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

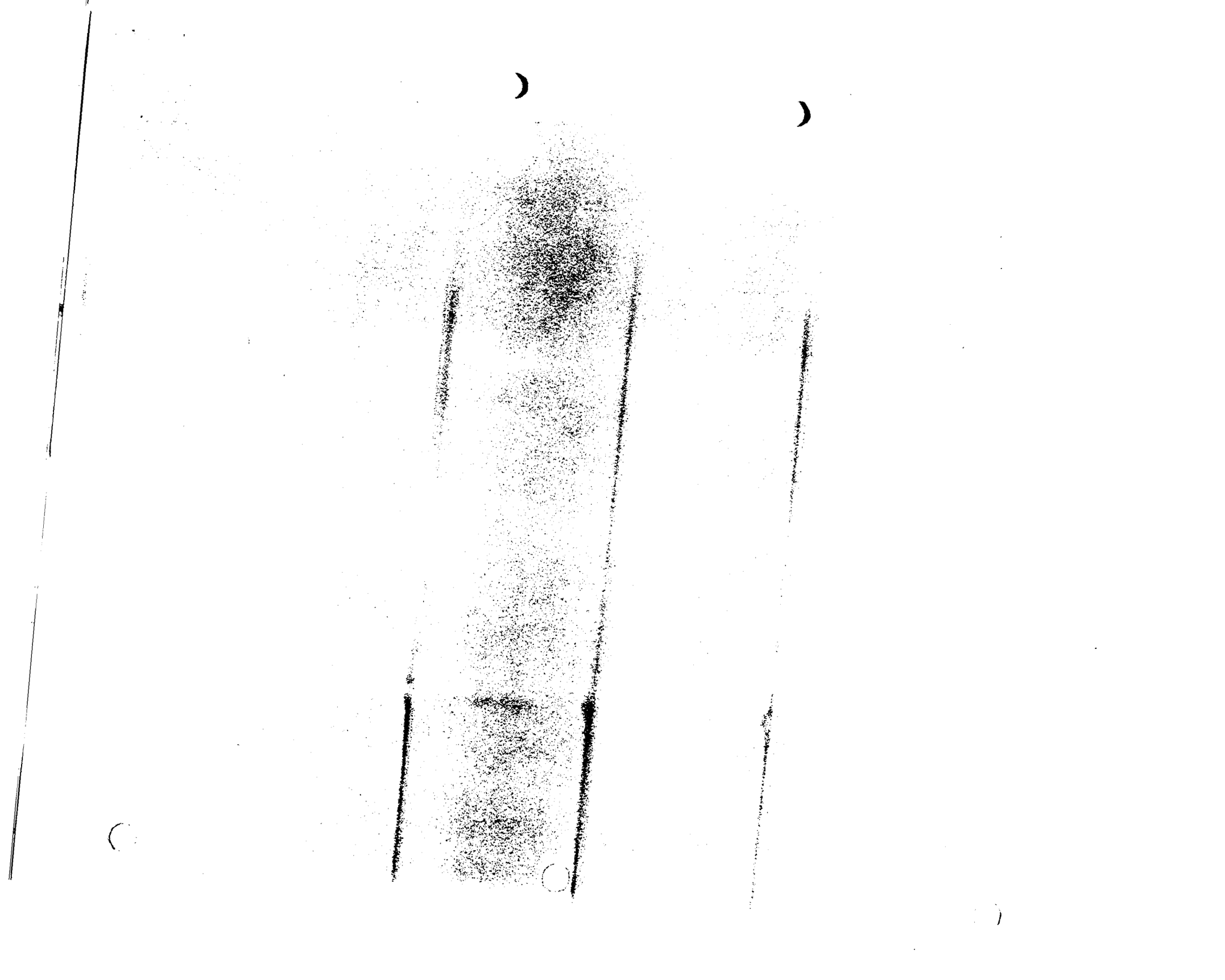
$$CRI = IDI * SFI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$CRIV = IDIV * SFI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$CRIG = IDIG * SFO$$



Total Non-Cancer Hazard Index
Off-Site Drainage Ditch
Riverdale Chemical Company - Chicago Heights, Illinois

Sampling Location	Analyte							Total Non-Cancer HI
	Aldrin	Dieldrin	Chlordane	Heptachlor	Heptachlor Epoxide	Toxaphene	2,3,7,8-TCDD	
SL85-1	5.43E-05	6.35E-05	5.43E-05	3.26E-06	1.30E-03	0.00E+00	NA	1.48E-03
SL86-1	1.85E-02	1.99E-02	1.17E-02	8.31E-06	7.60E-03	0.00E+00	NA	5.76E-02
SL86-3	5.43E-04	1.66E-04	6.79E-05	3.91E-06	1.30E-04	0.00E+00	NA	9.11E-04
SL87-1	1.14E-04	2.80E-04	1.09E-04	3.91E-06	7.60E-04	0.00E+00	NA	1.27E-03
SL87-3	5.97E-05	6.84E-05	5.97E-05	3.58E-06	1.19E-04	0.00E+00	NA	3.11E-04
SL87-3 Dup	5.70E-05	6.68E-05	5.70E-05	3.42E-06	1.14E-04	0.00E+00	NA	2.98E-04
SL88-1	6.24E-05	2.83E-04	1.10E-04	3.75E-06	1.25E-04	0.00E+00	NA	5.84E-04
SL89-1 (3)	1.14E-04	6.52E-04	2.61E-04	3.91E-06	1.68E-04	0.00E+00	NA	1.20E-03

Notes:

(1) Risk was calculated based on assumptions in EE/CA created by Ecology and Environment, Inc.

(2) If the analyte concentration was below method detection limit, half of the method detection limit was used as the exposure point concentration (EPC).

(3) Sample collected from low-lying area.

NA - Not Analyzed

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL85-1

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Hazard Quotient	Risk Percentage %
		Oral (RFDO)	Dermal (RFDD)	Inhalation (RFDI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime HQ (HQD), unitless	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime HQ (HQIS), unitless	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime HQ (HQIV), unitless	Amount Ingested (IDIG), (mg/kg-d)	Lifetime HQ (HQIG), unitless		
PESTICIDES/PCBs																	
Aldrin	1 0E-03	3 0E-05	3 0E-05		1	0 10		6 8E-10	2 3E-05	6.2E-14				9 5E-10	3 2E-05	5 4E-05	3.67
Dieldrin	2 0E-03	5 0E-05	5 0E-05		1	0 10		1 3E-09	2 6E-05	1.2E-13				1.9E-09	3.7E-05	6 4E-05	4.30
Chlordane	2 0E-03	6 0E-05	6 0E-05		1	0 10		1 4E-09	2.3E-05	1.2E-13				1 9E-09	3.2E-05	5 4E-05	3 67
Heptachlor	1 0E-03	5 0E-04	5 0E-04		1	0 10		6 8E-10	1 4E-06	6.2E-14				9 5E-10	1 9E-06	3 3E-06	0 22
Heptachlor epoxide	1 2E-02	1 5E-05	1.5E-05		1	0 10		8 1E-09	5 4E-04	7.4E-13				1 1E-08	7.6E-04	1 3E-03	88.14
Toxaphene	1 0E-01	NI	NI		1	0 10		6 8E-08		6 2E-12				9 5E-08			
DIOXIN																	
2,3,7,8-TCDD					1	0 10											
No samples collected																	
Total Noncancer Hazard									6 1E-04						8 7E-04	1 5E-03	100

NI = No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL86-1

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d: Oral (RFDO)	Reference Doses, mg/kg-d: Dermal (RFDD)	Reference Doses, mg/kg-d: Inhalation (RFDI)	Absorption factor, unitless: Oral (ABO)	Absorption factor, unitless: Drm (ABS)	Volatilization factor (VF), m³/kg	Dermal Absorption: Amount Absorbed (IDD), mg/kg-d	Dermal Absorption: Lifetime HQ (HQD), unitless	Volatile Inhalation from soil dust: Amount Inhaled (IDIS), (mg/kg-d)	Volatile Inhalation from soil dust: Lifetime HQ (HQIS), unitless	Volatile Inhalation from volatiles: Amount Inhaled (IDIV), (mg/kg-d)	Volatile Inhalation from volatiles: Lifetime HQ (HQIV), unitless	Ingestion: Amount Ingested (IDIG), (mg/kg-d)	Ingestion: Lifetime HQ (HQIG), unitless	Total Hazard Quotient	Risk Percentage %
PESTICIDES/PCBs																	
Aldrin	3 4E-01	3 0E-05	3 0E-05		1	0 10		2 3E-07	7 7E-03	2 1E-11				3 2E-07	1 1E-02	1 8E-02	32 04
Dieldrin	6 1E-01	5 0E-05	5 0E-05		1	0 10		4 1E-07	8 2E-03	3 8E-11				5 8E-07	1 2E-02	2 0E-02	34 49
Chlordane	4 3E-01	6 0E-05	6 0E-05		1	0 10		2 9E-07	4 8E-03	2 7E-11				4 1E-07	6 8E-03	1 2E-02	20 26
Heptachlor	2 6E-03	5 0E-04	5 0E-04		1	0 10		1 7E-09	3 4E-06	1 6E-13				2 4E-09	4 9E-06	8 3E-06	0 01
Heptachlor epoxide	7 0E-02	1 5E-05	1 5E-05		1	0 10		4 7E-08	3 2E-03	4 3E-12				6 7E-08	4 5E-03	7 6E-03	13 19
Toxaphene	2 6E-01	NI	NI		1	0 10		1 7E-07		1 6E-11				2 4E-07			
DIOXIN																	
2,3,7,8 TCDD					1	0 10											
No samples collected																	
Total Noncancer Hazard									2 4E-02						3 4E-02	5 8E-02	100

NI = No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm²)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction Inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m³/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m³/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm²/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL86-3

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Hazard Quotient	Risk Percentage %
		Oral (RFDO)	Dermal (RFDD)	Inhalation (RFDI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime HQ (HQD), unitless	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime HQ (HQIS), unitless	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime HQ (HQIV), unitless	Amount Ingested (IDIG), (mg/kg-d)	Lifetime HQ (HQIG), unitless		
PESTICIDES/PCBs																	
Aldrin	1 0E-02	3 0E-05	3 0E-05		1	0 10		6 8E-09	2 3E-04	6 2E-13				9 5E-09	3 2E-04	5 4E-04	59 59
Dieldrin	5 1E-03	5 0E-05	5 0E-05		1	0 10		3 4E-09	6 9E-05	3 2E-13				4 9E-09	9 7E-05	1 7E-04	18 23
Chlordane	2 5E-03	6 0E-05	6 0E-05		1	0 10		1 7E-09	2 8E-05	1 5E-13				2 4E-09	4 0E-05	6 8E-05	7 45
Heptachlor	1 2E-03	5 0E-04	5 0E-04		1	0 10		8 1E-10	1 6E-06	7 4E-14				1 1E-09	2 3E-06	3 9E-06	0 43
Heptachlor epoxide	1 2E-03	1 5E-05	1 5E-05		1	0 10		8 1E-10	5 4E-05	7 4E-14				1 1E-09	7 6E-05	1 3E-04	14 30
Toxaphene	1 2E-01	NI	NI		1	0 10		8 1E-08		7 4E-12				1 1E-07			
DIOXIN																	
2,3,7,8-TCDD					1	0.10											
No samples collected																	
Total Noncancer Hazard									3 8E-04						5 3E-04	9 1E-04	100

NI = No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingusted, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL87-1

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Hazard Quotient	Risk Percentage %
		Oral (RFDO)	Dermal (RFDD)	Inhalation (RFDI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime HQ (HQD), unitless	Amount Inhaled (IDIS) (mg/kg-d)	Lifetime HQ (HQIS), unitless	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime HQ (HQIV), unitless	Amount Ingested (IDIG) (mg/kg-d)	Lifetime HQ (HQIG), unitless		
PESTICIDES/PCBs																	
Aldrin	2 1E-03	3 0E-05	3 0E-05		1	0 10		1 4E-09	4 7E-05	1 3E-13				2 0E-09	6 7E-05	1 1E-04	9 00
Dieldrin	8 6E-03	5 0E-05	5 0E-05		1	0 10		5 8E-09	1 2E-04	5 3E-13				8 2E-09	1 6E-04	2 8E-04	22 12
Chlordane	4 0E-03	6 0E-05	6 0E-05		1	0 10		2 7E-09	4 5E-05	2 5E-13				3 8E-09	6 4E-05	1 1E-04	8 57
Heptachlor	1 2E-03	5 0E-04	5 0E-04		1	0 10		8 1E-10	1 6E-06	7 4E-14				1 1E-09	2 3E-06	3 9E-06	0 31
Heptachlor epoxide	7 0E-03	1 5E-05	1 5E-05		1	0 10		4 7E-09	3 2E-04	4 3E-13				6 7E-09	4 5E-04	7 6E-04	60.00
Toxaphene	1 2E-01	NI	NI		1	0 10		8 1E-08		7 4E-12				1 1E-07			
DIOXIN																	
2,3,7,8 TCDD	1 9E-06				1	0 10		1 3E-12		1 2E-16				1 8E-12			
Total Noncancer Hazard									5 2E-04						7 4E-04	1 3E-03	100

NI – No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1.00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL87-3

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Hazard Quotient	Risk Percentage %
		Oral (RFDO)	Dermal (RFDD)	Inhalation (RFDI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime HQ (HQD), unitless	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime HQ (HQIS), unitless	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime HQ (HQIV), unitless	Amount Ingested (IDIG), (mg/kg-d)	Lifetime HQ (HQIG), unitless		
PESTICIDES/PCBs																	
Aldrin	1 1E-03	3 0E-05	3 0E-05		1	0 10		7 4E-10	2 5E-05	6 8E-14				1 0E-09	3 5E-05	6 0E-05	19 21
Dieldrin	2 1E-03	5 0E-05	5 0E-05		1	0 10		1 4E-09	2 8E-05	1 3E-13				2 0E-09	4 0E-05	6 8E-05	22 00
Chlordane	2 2E-03	6 0E-05	6 0E-05		1	0 10		1 5E-09	2 5E-05	1 4E-13				2 1E-09	3 5E-05	6 0E-05	19 21
Heptachlor	1 1E-03	5 0E-04	5 0E-04		1	0 10		7 4E-10	1 5E-06	6 8E-14				1 0E-09	2 1E-06	3 6E-06	1 15
Heptachlor epoxide	1 1E-03	1 5E-05	1 5E-05		1	0 10		7 4E-10	5 0E-05	6 8E-14				1 0E-09	7 0E-05	1 2E-04	38 42
Toxaphene	1 1E-01	NI	NI		1	0 10		7 4E-08		6 8E-12				1 0E-07			
DIOXIN																	
2,3,7,8-TCDD	1 2E-06				1	0 10		8 1E-13		7 4E-17				1 1E-12			
Total Noncancer Hazard									1 3E-04						1 8E-04	3 1E-04	100

NI = No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL87-3Dup

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Hazard Quotient	Risk Percentage %
		Oral (RFDO)	Dermal (RFDD)	Inhalation (RFDI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime HQ (HQD), unitless	Amount Inhaled (IDIS) (mg/kg-d)	Lifetime HQ (HQIS), unitless	Amount Inhaled (IDIV) (mg/kg-d)	Lifetime HQ (HQIV), unitless	Amount Ingested (IDIG) (mg/kg-d)	Lifetime HQ (HQIG), unitless		
PESTICIDES/PCBs																	
Aldrin	1 1E-03	3 0E-05	3 0E-05		1	0 10		7 1E-10	2 4E-05	6 5E-14				1 0E-09	3 3E-05	5 7E-05	19 12
Dieldrin	2 1E-03	5 0E-05	5 0E-05		1	0 10		1 4E-09	2 8E-05	1 3E-13				2 0E-09	3 9E-05	6 7E-05	22 39
Chlordane	2 1E-03	6 0E-05	6 0E-05		1	0 10		1 4E-09	2 4E-05	1 3E-13				2 0E-09	3 3E-05	5 7E-05	19 12
Heptachlor	1 1E-03	5 0E-04	5 0E-04		1	0 10		7 1E-10	1 4E-06	6 5E-14				1 0E-09	2 0E-06	3 4E-06	1 15
Heptachlor epoxide	1 1E-03	1 3E-05	1 3E-05		1	0 10		7 1E-10	4 7E-05	6 5E-14				1 0E-09	6 7E-05	1 1E-04	38 23
Toxaphene	1 1E-01	NI	NI		1	0 10		7 1E-08		6 5E-12				1 0E-07			
DIOXIN																	
2,3,7,8-TCDD	1 7E-07				1	0 10		1 1E-13		1 1E-17				1 6E-13			
Total Noncancer Hazard									1 2E-04						1 7E-04	3 0E-04	100

NI = No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm^2)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction Inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL88-1

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Hazard Quotient	Risk Percentage %
		Oral (RFDO)	Dermal (RFDD)	Inhalation (RFDI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime HQ (HQD), unitless	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime HQ (HQIS), unitless	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime HQ (HQIV), unitless	Amount Ingested (IDIG), (mg/kg-d)	Lifetime HQ (HQIG), unitless		
PESTICIDES/PCBs																	
Aldrin	1 2E-03	3 0E-05	3 0E-05		1	0 10		7 8E-10	2 6E-05	7 1E-14				1 1E-09	3 7E-05	6 2E-05	10 68
Dieldrin	8 7E-03	5 0E-05	5 0E-05		1	0 10		5 9E-09	1 2E-04	5 4E-13				8 3E-09	1 7E-04	2 8E-04	48 49
Chlordane	4 1E-03	6 0E-05	6 0E-05		1	0 10		2 7E-09	4 6E-05	2 5E-13				3 9E-09	6 4E-05	1 1E-04	18 81
Heptachlor	1 2E-03	5 0E-04	5 0E-04		1	0 10		7 8E-10	1 6E-06	7 1E-14				1 1E-09	2 2E-06	3 7E-06	0 64
Heptachlor epoxide	1 2E-03	1 5E-05	1 5E-05		1	0 10		7 8E-10	5 2E-05	7 1E-14				1 1E-09	7 3E-05	1 2E-04	21 37
Toxaphene	1 2E-01	NI	NI		1	0 10		7 8E-08		7 1E-12				1 1E-07			
DIOXIN																	
2,3,7,8-TCDD					1	0 10											
No samples collected																	
Total Noncancer Hazard									2 4E-04						3 4E-04	5 8E-04	100

NI = No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm^2)	0 122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

RME ADULT CONSTRUCTION WORKER NON-CANCER UNIT RISK FROM EXPOSURE TO COPCs IN SUBSURFACE SOIL
SAMPLING LOCATION SL89-1

Chemical Name	Concentration in soil (CS), mg/kg	Reference Doses, mg/kg-d			Absorption factor, unitless		Volatilization factor (VF), m^3/kg	Dermal Absorption		Volatile Inhalation from soil dust		Volatile Inhalation from volatiles		Ingestion		Total Hazard Quotient	Risk Percentage %
		Oral (RFDO)	Dermal (RFDD)	Inhalation (RFDI)	Oral (ABO)	Drm (ABS)		Amount Absorbed (IDD), mg/kg-d	Lifetime HQ (HQD), unitless	Amount Inhaled (IDIS), (mg/kg-d)	Lifetime HQ (HQIS), unitless	Amount Inhaled (IDIV), (mg/kg-d)	Lifetime HQ (HQIV), unitless	Amount Ingested (IDIG), (mg/kg-d)	Lifetime HQ (HQIG), unitless		
PESTICIDES/PCBs																	
Aldrin	2 1E-03	3 0E-05	3 0E-05		1	0 10		1 4E-09	4 7E-05	1.3E-13				2 0E-09	6 7E-05	1 1E-04	9 51
Dieldrin	2 0E-02	5 0E-05	5 0E-05		1	0 10		1 4E-08	2 7E-04	1.2E-12				1 9E-08	3 8E-04	6 5E-04	54 37
Chlordane	9 6E-03	6 0E-05	6 0E-05		1	0 10		6 5E-09	1 1E-04	5.9E-13				9.2E-09	1 5E-04	2.6E-04	21.75
Heptachlor	1 2E-03	5 0E-04	5 0E-04		1	0 10		8 1E-10	1.6E-06	7.4E-14				1 1E-09	2 3E-06	3 9E-06	0 33
Heptachlor epoxide	1 6E-03	1 5E-05	1 5E-05		1	0 10		1.0E-09	7.0E-05	9 6E-14				1 5E-09	9 9E-05	1 7E-04	14 04
Toxaphene	1 2E-01	NI	NI		1	0 10		8 1E-08		7 4E-12				1 1E-07			
DIOXIN																	
2,3,7,8-TCDD					1	0 10											
No samples collected																	
Total Noncancer Hazard									5.0E-04						7 0E-04	1 2E-03	100

NI = No Information Available

ASSUMPTIONS

Averaging Time, AT (yr)	1
Adherence Factor, AF (mg/cm^4)	0.122
Body Weight, BW (kg)	71.8
Contaminant Fraction, CF (unitless)	1
Conversion Factors	
Mass, MCF (kg/mg)	1 00E-06
Time, TCF (d/yr)	365
Exposure Duration	
Dermal, EDD (yr)	1
Inhalation from soil, EDIS (yr)	1
Inhalation from volatiles, EDIV (yr)	1
Ingestion, EDIG (yr)	1
Exposure Frequency, EF (d/yr)	250
Fraction Ingested, FIIG (unitless)	1
Fraction inhaled, FIIV (unitless)	1
Inhalation Rate, IR (m^3/d)	30
Ingestion Rate, IGR (mg/d)	100
Particulate Emission Factor, PEF (m^3/kg)	4630000000
Respirable Fraction, RF (unitless)	1
Skin surface area, SA (cm^2/d)	5,800

EQUATIONS

$$IDD = \frac{CS * MCF * SA * AF * ABS * EF * EDD}{BW * AT * TCF}$$

$$HQD = IDD / RFDD$$

$$IDIS = \frac{CS * IR * RF * CF * EF * EDIS}{BW * AT * TCF * PEF}$$

$$HQIS = IDIS / RFDI$$

$$IDIV = \frac{CS * (1/VF) * IR * FIIV * EF * EDIV}{BW * AT * TCF}$$

$$HQIV = IDIV / RFDI$$

$$IDIG = \frac{CS * IGR * FIIG * MCF * EF * EDIG}{BW * AT * TCF}$$

$$HQIG = IDIG / RFDO$$

Appendix B
TEQ Calculations

Tetrachlorodibenzo-p-dioxin Toxic Equivalent Concentratic Calculations Using International Toxic Equivilant Factors

ANALYTE		SL87-1 ng/kg		SL87-3 ng/kg		SL87-3 DUP ng/kg	
	I-TEFs						
2378-TCDD	1	1.90E+00	1.90E+00	1.20E+00	1.20E+00	1.70E-01	1.70E-01
12378-PeCDD	0.5	2.90E-01	1.45E-01	3.05E-01	1.53E-01	3.00E-01	1.50E-01
123478-HxCDD	0.1	1.60E-01	1.60E-02	1.80E-01	1.80E-02	1.75E-01	1.75E-02
123678-HxCDD	0.1	1.80E-01	1.80E-02	2.05E-01	2.05E-02	2.00E-01	2.00E-02
123789-HxCDD	0.1	3.20E-01	3.20E-02	1.80E-01	1.80E-02	1.75E-01	1.75E-02
1234678-HpCDD	0.01	2.60E+00	2.60E-02	1.45E-01	1.45E-03	1.80E-01	1.80E-03
OCDD	0.001	2.00E+01	2.00E-02	5.50E-01	5.50E-04	9.00E-01	9.00E-04
2378-TCDF	0.1	2.30E+00	2.30E-01	3.95E-01	3.95E-02	1.35E-01	1.35E-02
12378-PeCDF	0.05	1.60E-01	8.00E-03	1.65E-01	8.25E-03	1.70E-01	8.50E-03
23478-PeCDF	0.5	1.55E-01	7.75E-02	1.65E-01	8.25E-02	1.70E-01	8.50E-02
123478-HxCDF	0.1	1.65E-01	1.65E-02	1.45E-01	1.45E-02	1.50E-01	1.50E-02
123678-HxCDF	0.1	1.65E-01	1.65E-02	1.45E-01	1.45E-02	1.45E-01	1.45E-02
123789-HxCDF	0.1	1.95E-01	1.95E-02	1.70E-01	1.70E-02	1.65E-01	1.65E-02
234678-HxCDF	0.1	1.85E-01	1.85E-02	1.60E-01	1.60E-02	1.75E-01	1.75E-02
1234678-HpCDF	0.01	4.20E-01	4.20E-03	1.60E-01	1.60E-03	1.90E-01	1.90E-03
1234789-HpCDF	0.01	1.50E-01	1.50E-03	1.75E-01	1.75E-03	2.05E-01	2.05E-03
OCDF	0.001	8.50E-01	8.50E-04	2.35E-01	2.35E-04	2.20E-01	2.20E-04
	ng/kg	TEQ	2.55E+00	TEQ	1.61E+00	TEQ	5.52E-01
	mg/kg		2.55E-06		1.6E-06		5.5E-07

Riverdale Chemical Company
Prepared by: Brendan McLennan
Checked by: RAM

Appendix C
Evaluation of Data Quality

EVALUATION OF DATA QUALITY FROM LABORATORY ANALYSES OF SAMPLES COLLECTED AT THE RIVERDALE SITE CHICAGO HEIGHTS, ILLINOIS

PREPARED BY
RMT, INC.
MADISON, WISCONSIN

June 2001

Table of Contents

List of Tables

Section 1
Summary of Sampling Program

RMT, Inc. (RMT), collected soil samples from the Riverdale Site. The sampling program and procedures were performed in accordance with a workplan (RMT, 2000) approved by the United States Environmental Protection Agency (USEPA). Primary field samples were analyzed for the constituents listed in Section 1 of the Quality Assurance Project Plan for the Phase I Removal Action Workplan (RMT, 2000). Field quality control samples were collected in accordance with the approved workplan.

Severn Trent Laboratories, (STL) Inc., North Canton, Ohio, and West Sacramento, California, analyzed the samples. A complete data validation was performed on a portion (10 percent) of the data collected during March 2001. A cursory QC data review was performed on other selected samples.

Section 2
Data Quality Evaluation

Data validation of a portion of the Riverdale Site data was accomplished by comparing the quality assurance and quality control (QA/QC) results contained in the laboratory data packages with the requirements specified in the approved Quality Assurance Project Plan (RMT, 2000); the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 1994); the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 1999); and the general guidelines published in SW-846, Test Methods for Evaluating Solid Waste, (USEPA, 1996), where appropriate. Raw data, chain-of-custody forms, initial and continuing calibrations, blanks, laboratory control samples (LCSs), spike and duplicate analyses, and ICP serial dilution and ICP interference check sample results received particular attention during the complete data review. The samples that only received a cursory data review included checks for blank, MS/MSD, and surrogate spike analyses for pesticides/PCBs. The discussion that follows describes the QA/QC results and evaluation.

2.1 Usability

Soil samples were analyzed by STL, Inc., for TCL organochlorine pesticides/PCBs, volatile organic compounds (VOCs), and TCL semivolatile organic compounds (SVOCs) (SOW OLM03.1); target analyte list (TAL) metals (SOW ILM04.0); and chlorophenoxy herbicides (Method 8151A SW-846). Selected samples were analyzed for 2,3,7,8-PCDD/2,3,7,8-PCDF (polychlorinated dibenzo-p-dioxin/ polychlorinated dibenzofuran) (Methods 8290 SW-846). Additionally, matrix spikes/matrix spike duplicates (MSs/MSDs), and field duplicates were collected and analyzed for quality control purposes.

The data quality objectives for the project were met, and the data are usable for the purposes defined in the approved workplan. The procedures specified in the methods were implemented, and the data packages contained all deliverables specified in the QAPP.

2.2 Holding Times and Sample Preservation

Required holding times were met. VOC analyses were performed within 14 days of sample collection. The samples were extracted for SVOC, pesticide/PCB, and herbicide analyses within 14 days of sample collection, and were analyzed within 40 days after extraction. The extractions for dioxin analysis were performed within 30 days of sample collection, and the analyses were

performed within 45 days after extraction. Mercury analysis was performed within 28 days of the sample collection. Other metals were analyzed for within the 6-month time requirement.

2.3 Instrument Performance Check

Satisfactory gas chromatograph/mass spectrometer (GC/MS) instrument performance checks ensure adequate mass resolution, compound identification, and, to some degree, sensitivity. The criteria established for instrument performance checks were met at all times. The analyses of the instrument performance check solutions were performed at the required frequency (every 12 hours of sample analysis per instrument). Bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP) were used as check compounds in VOC and SVOC analyses, respectively.

In the HRGC/HRMS analysis by isotope dilution, perfluorokerosene (PFK) was used for tuning the mass spectrometer to meet the required minimum resolving power of 10,000. The resolution and mass/charge (m/z) ratios of five reference peaks were monitored. The criteria for the compound resolution and the maximum difference between the exact m/z and theoretical m/z were met at all times. The lock masses varied by less than 20 percent.

The ion abundance ratio, signal-to-noise ratio, retention times, and the mass assignment criteria were met for all instrument performance checks. The ion abundances were correctly normalized to the appropriate m/z (mass/charge) ratio.

2.4 Calibrations

Initial calibration establishes that the instrument is capable of acceptable performance at the beginning of the analytical sequence and that the calibration curve is linear. Continuing calibration verifies the calibration and evaluates daily instrument performance.

2.4.1 GC/MS Calibration

Initial calibrations containing target compounds and system monitoring compounds were performed at the required frequency and concentration levels. Initial calibrations of the GC/MS at five concentrations were performed after instrument performance check criteria were met and prior to the analysis of samples and blanks. Internal standards were added to all calibration standards and samples (including blanks and MS/MSD). The GC/MS calibration was verified every 12 hours with one mid-range standard.

The minimum response factor (RF) criterion was met in the GC/MS analyses. The stability of the compound response factors was indicated by acceptable percent relative

standard deviation (%RSD) values of the RFs. The percent difference (% D) criteria for continuing calibration were met.

2.4.2 HRGC/HRMS Calibration with Isotope Dilution

Initial calibration was established by a five-point initial calibration curve, encompassing the method-specified range of 17 native; 9 isotopically labeled ($^{13}C_{12}$) 2,3,7,8-PCDDs and PCDFs; one labeled ($^{37}Cl_4$) cleanup standard; and two labeled ($^{13}C_{12}$) recovery standards. A five-point calibration was also performed using an alternate GC column and native and labeled ($^{13}C_{12}$) 2,3,7,8-TCDD and TCDF (tetrachlorodibenzo-p-dioxin and tetrachlorodibenzofuran) standards in order to resolve the presence of 2,3,7,8-TCDF. Native and unlabeled 2,3,7,8-PCDDs/PCDFs and labeled non-2,3,7,8-TCDDs were used to define the absolute retention times, the relative retention times (RRTs), and the compound resolution. The relative responses (RRs) of native to labeled compounds versus the concentration in the standard solutions for the 2,3,7,8-PCDDs/PCDFs and the labeled analogs were determined using the area responses of the primary and secondary m/z, as specified in the method.

The resolution between the adjacent TCDD/TCDF isomers was acceptable (valley height <25 percent). The signal-to-noise ratios, the mass-to-charge (m/z) abundance ratios, and the RTs of the native and labeled PCDD/PCDF standards were within the method-specified limits. Calibration verification was performed using the method-specified concentrations in the midpoint calibration standards.

2.4.3 GC Calibration

In the GC/ECD (gas chromatograph/electron capture detector) analysis of chlorophenoxy herbicides and organochlorine pesticides/PCBs, a performance evaluation mixture (PEM) was analyzed during the initial calibration sequence and in every 12-hour analytical period. Initial calibration of individual standard mixtures of herbicides, organochlorine pesticides, and multicomponent target compounds were performed on two GC columns at the required frequency and concentration level. A five-point initial calibration was performed for herbicides, a three-point initial calibration was performed for single-response pesticides, and a one-point calibration was performed for multicomponent pesticides/PCBs. The percent RSDs of the calibration factors were within QC criteria.

Continuing calibration for herbicides, pesticides, and PCBs, including the analyses of the PEM, the midpoint concentration of herbicides, pesticides, and Aroclors, was performed to verify the calibration and evaluate instrument performance. The Percent Difference

(%D) values were within the QC limit on both columns, and the samples were bracketed with acceptable results. Good peak resolution was achieved, and RT (retention time) and calibration factors were available for each peak. The RTs for the herbicides, single-response pesticides, and surrogates were within the correct RT windows. Adequate calibration bracketed the samples, and overall, good instrument stability and performance were maintained. The florisil cartridge checks and GPC calibration checks were acceptable during the pesticide/PCB analyses.

2.4.4 Inorganic Calibration

Initial calibrations and continuing calibration verifications, including initial and continuing calibration blanks, were performed at the required frequency and concentration level as specified in the methods. All calibration results were within QC acceptance criteria. Low levels of metals were detected in the calibration blanks at allowable levels.

Raw data (*i.e.*, instrument printouts and bench sheets) were reviewed to assess the impact of calibration blank detections on the reported metals concentrations in the samples. Data validation qualifiers were added to sample results on the basis of detections in the calibration and preparation blanks. Some samples were qualified with "u" flags and were considered nondetected (see below).

2.5 Internal Standard Responses and Retention Times in the GC/MS Analysis

The quantitative determination of the VOC, SVOC, and 2,3,7,8-PCDD/PCDF compounds is based on the use of internal standards added immediately prior to analysis or extraction. Therefore, satisfactory internal standard responses in all calibration standards, samples, and blanks are critical.

Three internal standard constituents (bromochloromethane; 1,4-difluorobenzene; and chlorobenzene-d5) were used in the VOC analysis. Six internal standard constituents (1,4 dichlorobenzene-d4; naphthalene-d8; acenaphthene-d10; phenanthrene-d10; chrysene-d12; and perylene-d12) were used in the SVOC analysis.

$^{13}C_{12}$-2,3,7,8-TCDD; $^{13}C_{12}$-1,2,3,7,8-PeCDD; $^{13}C_{12}$-1,2,3,6,7,8-HxCDD; $^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD; $^{13}C_{12}$-OCDD; $^{13}C_{12}$-2,3,7,8-TCDF; $^{13}C_{12}$-1,2,3,7,8-PeCDF; $^{13}C_{12}$-1,2,3,4,7,8-HxCDF; and $^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF were the internal standards used in the 2,3,7,8-PCDD/PCDF analysis using Method 8290 (SW-846).

With the exception of two samples (SL86-1 and SL88-1) for VOCs that had internal standard areas outside control limits, all internal standard area counts and retention times (RTs) were within the QC limits. The laboratory reanalyzed the VOC samples when the internal standards were outside control limits with similar results indicating sample matrix interference. Data validation qualifiers (j) were added to the affected VOCs to indicate the exceedences.

2.6 Compound Identification

To verify that organic compounds were not erroneously identified, the relative retention times (RRTs) of the samples were checked to see if they were within the standard RRT and if the mass spectra of the samples and standards matched. The ion abundance ratio and response factor criteria were met. The QC criteria of the GC analyses were acceptable: the retention times of the surrogates, matrix spikes, and analytical compounds were within the calculated RT windows in the GC analysis. No off-scale chromatographic peaks were present.

Tentatively identified compounds (TICs) were reported from several samples analyzed for VOCs and SVOCs. Some TIC constituents were present also in the method blanks.

When the final sample extract concentrations for the pesticides were sufficiently high during the GC/ECD analysis, the laboratory performed GC/MS confirmation analyses for the pesticides.

When the difference for the detected pesticide result between the two GC columns was greater than 25 percent, the laboratory qualified the result with a "P" flag. Some difference values were very high (up to several hundred percent). When the difference was greater then 30 percent, a data validation qualifier (j) was added to the pesticide result to suggest uncertainty in the sample result.

As required by the method, the presence of 2,3,7,8-TCDF in the samples was verified with a confirmation column during the Method 8290 analysis.

2.7 Method Blanks and Preparation Blanks

Method blanks and preparation blanks were analyzed for all analytical constituents to assess potential sample contamination resulting from laboratory procedures. A method or preparation blank (procedural blank) is carried through the same analytical steps (preparation and analysis) as the samples.

Acetone were detected in the VOC method blanks. Low levels of TIC constituents were detected in SVOC and VOC blanks. The same TICs were also detected in the field samples.

No 2,3,7,8-PCDD/2,3,7,8-PCDF, pesticides/PCBs, or herbicides were detected in the method blanks.

Preparation blanks were analyzed for the same inorganic parameters as the samples. Low levels of metals (below Quantitation Limits) were detected in preparation blanks analyzed for metal parameters. Raw data (*i.e.*, instrument printouts and bench sheets) were reviewed to assess the impact of calibration blank detections on the reported metals concentrations in the samples.

When a sample detection was associated with the blank detection for the organic target compounds, the laboratory qualified the sample result with a "B" flag. Data validation qualifiers were added to the sample data on the basis of blank contamination. When the concentration of a common laboratory contaminant, such as acetone, in the sample was less than 10 times the associated blank value, and when the concentrations of other constituents in the sample were less than five times the associated blank value, the sample results were qualified as nondetected ("u") in accordance with USEPA (1994 and 1999) data validation guidance. Detections of acetone were therefore qualified with a "u" flag. Some sample detections of beryllium, cadmium, and mercury were also qualified with "u" flags on the basis of blank contamination.

2.8 Instrument Blanks

Instrument blanks were analyzed by the GC/ECD for pesticide/PCB analyses to check that no carry-over problems were present. No pesticides or PCBs were detected in the instrument blanks. Observed retention times for the surrogates in the instrument blanks were within the retention time windows for the calibrations.

2.9 Holding/Storage Blanks

The laboratory holding/storage blank was analyzed for VOCs to assess potential sample contamination during sample storage. Low levels of acetone were detected in the holding blank. Low levels of TIC constituents were detected in the holding blank. The same TICs were also detected in the field samples. Data validation qualifiers were added to the sample results on the basis of holding blank detections (see above).

2.10 Matrix Spikes/Matrix Spike Duplicates

Matrix spikes (MSs) and matrix spike duplicates (MSDs) provide information about the effects of the sample matrix on the sample preparation and measurement performance. A matrix spike consists of a sample that is spiked with a group of target constituents representative of the method analytes and carried through the appropriate steps of the analysis, including extraction,

distillation, and digestion. Laboratory control sample analyses were performed for dioxins in place of the MS/MSD analysis in accordance with the method specifications.

Five spike compounds were used in one MS/MSD analysis performed for TCL VOCs with samples SL85-1 and SL86-3. The VOC spike analysis results were acceptable.

Eleven spike compounds were used in one MS/MSD analysis performed for TCL SVOCs with sample SL85-1. The MS recovery of pyrene from SL85-1 was below the control limit. However, the MSD recovery was acceptable. The RPD value for pentachlorophenol was above the control limit in sample SL-85-1. However, the individual recoveries were acceptable. All other SVOC spike recoveries and RPDs were acceptable.

Three spike compounds were used in the MS/MSD analysis for herbicides with sample SL51 and two other samples in the analytical batch with acceptable results.

Six single-response pesticides were used in the MS/MSD analysis for TCL organochlorine pesticides with samples SL85-1, SL90-7, SL117-6, SL138-1, and SL155-2. Because of the required sample dilution of SL155-2, the MS/MSD spikes of the pesticides were also diluted out. The recoveries of three pesticides were elevated in the MS analysis of SL117-6, and the recovery of one pesticide was elevated in the MSD analysis of this sample. The other pesticide spike analysis results were acceptable.

No data validation qualifiers were added to the sample results for the organic target compounds on the basis of MS/MSD results alone.

All analytical constituents were injected into the spike sample SL85-1 for TAL metals. The recovery of antimony was above the control limits. The sample result is not affected because no antimony was detected in the associated samples. The recovery of arsenic was below the control limits. The laboratory added "N" qualifiers to the associated sample results in the analytical batch for antimony and arsenic. A data validation qualifier (j) was also added to arsenic in sample SL85-1 to indicate that the reported concentration is approximate. All other spike analysis results for metals were within QC limits.

2.11 Laboratory Duplicate Analysis

Duplicate analysis was performed with sample SL85-1 for metal parameters to assess the precision of laboratory procedures. The RPD value for manganese was above control limits. The laboratory added an "*" qualifier to the associated sample results. A data validation qualifier (j) was also added to sample SL85-1 on the basis of this finding to indicate an approximate manganese concentration. All other duplicate analysis results for metals were within QC limits.

2.12 Surrogate/System Monitoring Compound (SMC) Spikes

Surrogate/SMC spikes are compounds similar to the analytes of interest in chemical behavior, but they are not normally found in environmental samples. Laboratory performance of individual samples and blanks was established by spiking all samples and blanks prior to extraction and analysis to determine surrogate/SMC spike recoveries among the standards, samples, blanks, PEMs, and MSs/MSDs in the sample and blank matrices.

Three surrogate compounds, 4-bromofluorobenzene (BFB); 1,2-dichloroethane-d4; and toluene-d8, were used in the VOC analysis. The surrogate used in the herbicide analysis was 2,4-dichlorophenylacetic acid. All VOC and herbicide surrogate results were within control limits.

SVOC surrogates included nitrobenzene-d5; 2-fluorobiphenyl; terphenyl-d14; phenol-d5; 2-fluorophenol; 2,4,6-tribromophenol; 2-chlorophenol-d4; and 1,2-dichlorobenzene-d4. The recovery of three of eight surrogates were outside the control limits during the analysis of one sample (SL88-1) for SVOCs. The method allows the recovery of one surrogate per fraction to be outside the control limits. All other QC results were within control limits. No action was taken during laboratory analysis or data validation.

Tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB) were used in pesticide/PCB analyses. The recovery of TCX from samples SL87-3Dup and the MSD of SL85-1 was slightly below the control limit. However, the recovery of DCB was acceptable. No action was taken during data validation because the exceedence was only minor.

2.13 Laboratory Control Samples

The laboratory control samples (LCSs) were used to monitor the overall performance of all steps in the analysis, including the sample preparation. All analytical constituents were used in the LCS analyses for metals, herbicides, and dioxins/furans. All LCS recoveries were within QC criteria.

2.14 ICP Serial Dilution Analysis

An ICP serial dilution analysis was performed with sample SL85-1 to determine if interferences due to the sample matrix were present. The serial dilution results were acceptable.

2.15 Field Duplicate Sample

One pair of field duplicates from SL87-3 was compared for the analytical parameters during data validation. No herbicides, pesticides, or PCBs were detected in the duplicate pair. Acetone was the only VOC that was reported from the duplicate pair. It was considered as nondetected during data validation on the basis of blank contamination. The bis(2-ethylhexyl)phthalate that

was detected in the duplicate from SL87-3, was not confirmed with the primary sample from the same location. The duplicate pair did not confirm the 2,3,7,8-TCDD that was detected in the primary sample from SL87-3.

Table 2 shows the comparison of the reported analytes in the duplicate pair. Relative percent difference (RPD) values were calculated for only those pairs in which both reported results were above the Limit of Quantitation. Constituents that were less than the Limit of Detection are not shown.

Heterogeneity of samples, difficult sample matrices, and the difficulty in replicating the analytical results from small sample aliquots decrease the precision expressed as an RPD between the duplicates. Field duplicates measure both field and laboratory precision. As expected, the variability is greater than for the laboratory duplicates, which measure only laboratory precision. Four RPD values calculated for the soil duplicate exceeded 50 percent.

There are no required criteria for field duplicate analysis comparability. Therefore, no data validation qualifiers were added to the sample data on the basis of these findings.

Section 3
References

RMT. 2000. Quality assurance project plan for the phase I removal action prepared for Riverdale Company, Chicago Heights, Illinois. Appendix A to the Workplan.

USEPA. 1994. USEPA contract laboratory program, national functional guidelines for inorganic data review.

USEPA. 1996. Test methods for evaluating solid waste; physical/chemical methods. SW-846.

USEPA. 1999. USEPA contract laboratory program, national functional guidelines for organic data review.

Table 1
Index of Laboratory and Data Validation Qualifiers

Laboratory Qualifiers

INORGANIC DATA	
B	Analyte value is below the Quantitation Limit but greater than or equal to the Instrument Detection Limit (IDL).
D	Analyte value is from a diluted analysis.
N	Spiked sample recovery is not within control limits.
U	Analyte was tested for but was not detected; value indicates the detection limit.
*	Duplicate analysis is not within control limits.
ORGANIC DATA	
A	The tentatively identified compound (TIC) is an aldol-condensation product.
B	Analyte was present in the method blank.
C	The presence of the compound was confirmed by GC/MS analysis.
D	Analyte value is from a diluted analysis.
E	Reported concentration exceeded the calibration range of the instrument.
J	Reported value is less than the reporting limit, but greater than zero, or when a tentatively identified compound is present.
N	Indicates presumptive evidence of a tentatively identified compound. Identification is based on mass spectral library search.
P	The difference for detected pesticide result between the two GC columns is greater than 25 percent.
U	The compound was analyzed for but not detected; the value indicates the detection limit.

Data Validation Qualifiers

b	Analyte was present in the trip blank.
ncu	If the presence of a compound reported from the GC/ECD analysis was not confirmed by GC/MS, data validation qualifiers (ncu) were added to the sample results in the summary data tables to indicate that the reported result from the GC analysis should be considered nondetected.
s	Analyte was present in the laboratory holding/storage blank.
u	Analyte was present at less than 10 times the concentration in the associated method (B), trip (b), field (f), and/or laboratory storage (S) blank for common laboratory contaminants, or at less than 5 times the blank concentration of other analytes, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).
j	When specific QC criteria are outside the established control limits, the reported concentration or the Quantitation Limit is approximate. When the difference for the detected pesticide result between the two GC columns was greater then 30 percent, a data validation qualifier (j) was added to the pesticide result to suggest uncertainty in the sample result.

Table 2
Detected Parameters in the Field Duplicate
(units mg/kg except where noted otherwise)

PARAMETER	SL87-3	SL87-3 DUP	RPD %
Aluminum	12,700	10,700	17
Arsenic	5.3 N	12.3 N	80
Barium	99.4	95.7	4
Beryllium	0.52 B	0.59 B	--
Calcium	3,080	2,120	37
Chromium	16.9	18.2	7
Cobalt	9.9 B	17.5	--
Copper	13.2	38.2	98
Iron	19,000	33,000	54
Lead	17.3	16.8	3
Magnesium	2,590	2,940	13
Manganese	475 *	540 *	13
Nickel	20.1	44.6	76
Potassium	964 B	1,100 B	--
Vanadium	22.7	27.9	21
Zinc	43.8	59.7	31
2,3,7,8-TCDD, µg/kg	0.0012	<0.00034	--
bis(2-ethylhexyl)phthalate, µg/kg	<420	240 J	--

Notes:
-- = one or both values are less than the Quantitation Limit; therefore, an RPD calculation is of limited significance and was not done.
B = reported value is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).
J = analyte value is estimated at below the Quantitation Limit.
N = spiked sample recovery was not within control limits.
* = duplicate analysis was not within control limits.

All other analytes were below Quantitation Limits.